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Abstract of the national paper of China

1. As early as in the most ancient times, China, a country with a long-standing history of civilization, had placed on record its world famous "four inventions" in the annals of world science and technology. Subsequently, ancient rocket technology was developed in China, pioneering the exploration of space. Since the founding of the People's Republic of China, great strides have been made from scratch in China's space science and technology and its applications, which have played a significant role in the modernization and construction of the country.

I. Development of space science and technology and its applications in China

A. Space science

2. Microgravity research in China started in the late 1980s. At present, complete systems for ground-based simulation experiments, short-term microgravity experiments and space experiments exist on a certain scale. A highly qualified professional team for laboratory research, theoretical analysis and numerical value simulation has been formed. Microgravity research in China is focused on applied basic studies and a number of results have been achieved in the fields of fluids under conditions of microgravity, space material science, space life science and biotechnology. For instance, many research experiments have been carried out in space on board China's own retrievable satellites: an α-LiIO3 growth experiment of transparent crystal in fluid under low temperature in space; a growth experiment of GaAs monocrystal of major diameter in space; an experiment with palladium silicon material on board satellites; and an experiment on the Marangoni convection effect based on co-crystal alloys. A device capable of recording the whole process of space experiments has been developed for real-time observation of growth in space, which has successfully recorded images of the whole process of liquation, liquefaction and crystallization of oxide crystalline materials. Other experiments include research on signature characterization of melting surfaces and interfaces between solids and liquids in space; profiling of the moisturizing properties of melting materials and their response at the liquid/solid interface; and the solidifying behaviour of metal alloys and compound materials in space. Research on processing methods, techniques and applications of bio-materials in space has prepared the basis for space pharmacy. Meanwhile, studies are also being conducted on biological effects in space, in search of new technologies and new thinking for regulating the process of life in space and obtaining new bio-materials.

3. China started its exploration of the space environment by means of rockets and balloons in the mid-1960s. In early 1970s, exploration of and research on the space environment and its effects was begun on board satellites. Dozens of probes and sensors on board satellites for investigation of the space environment and its effects have been developed. Space environmental exploration and research has been carried out on energy electrons, protons, heavy ions and their single particle effects, radiation dosage effects, space thermal plasma, upper atmospheric density and components and solar energy electromagnetic radiation. In the field of space astronomy, China has also conducted ground-based observation of and research on the fine structures of the solar magnetic field, as well as research in solar physics and the solar-terrestrial space environment.

4. In support of the Solar-Terrestrial Energy Programme to enhance human understanding of the relationship between the Sun and the Earth, the China Natural Science Foundation initiated research on the energy transmission process of the solar-terrestrial system, which achieved important results in understanding the correlation between solar activities and instantaneous interplanetary changes, the coupling of inter-planetary solar winds and the magnetosphere and the terrestrial-space coupling system.

5. China's scientific communities in astronomy have made new breakthroughs in developing ground-based systems to explore the solar magnetic field. A two-dimensional simultaneous spectrometer has been invented and the development of ground-based equipment such as telescopes for solar magnetic field observation and multi-channel solar telescopes as well as airborne equipment of 80 cm in diameter has culminated in success.

6. China's research in the field of carrying capacities on balloons and support technologies for monitoring and control has expanded the application of balloons in space science. China has manufactured and successfully launched scientific balloons in the size range 300,000-400,000 m^3 with a maximum payload of 2,000 kg. Each year 5-10 scientific balloons are released. Microgravity research has been carried out with falling capsules from balloons and valuable results have been achieved in microgravity combustion and electro-fusion of plant and animal cells.

B. Space technology

7. China started its development of launch vehicles in 1965 and successfully launched the DFH-1 satellite into space in 1970 for the first time with its own CZ-1 rocket. Today, CZ rockets have formed their own series, capable of launching into space domestic and foreign satellites for various purposes and of various dimensions. By the end of 1998, 55 launches had been made with rockets of the CZ series; since 1996, the CZ series has made 13 consecutive successful launches. Since 1985, when it entered the international market, the CZ series has succeeded in launching 23 foreign-made satellites into space.

8. China has developed and launched more than 40 satellites of different categories. Among them are retrievable scientific experiment satellites that are in the front rank of advanced technologies in the world, communication broadcasting satellites that have reached the level of medium capacity and geostationary meteorological satellites that have attained the international standards of the early 1990s.

C. The Application of Space Science

9. There are 20 specialized and 15 regional remote sensing centres in China. Some 80 per cent of more than 100 digital imaging systems are devoted to the processing of remote sensing data. China has successively developed aerospace remote sensing platforms, sounding balloons, sounding rockets, ground equipment and digital gathering platforms, constituting a

comprehensive geo-monitoring network at multiple levels. For the purpose of aeronautic remote sensing, China is equipped with finely scaled multi-spectral scanners, multi-spectral imaging spectrometers, side-view synthetic aperture radar and radar altimeters, which form a ground-based, airborne and space-borne all-weather real-time monitoring system in coordination with satellite platforms.

10. Meta-data on nationwide and provincial land use have been completed with multi-spectral images from Landsat and surveys have been carried out with the help of land survey satellites on land use, water resources, forest resources, changes in poor land and land planning in some areas. The productivity of farm products such as winter wheat, corn and rice has been assessed by means of remote sensing. Some typical models for application have been built. Research on improvement of existing models of crop growth monitoring by remote sensing has been conducted drawing on high-resolution spectral data and multi-angle monitoring of crop growth. In the area of geological map configuration, the combined working methods of remote sensing technology and large-scale multi-picture surveys have reduced the actual costs by one third and the length of field survey routes by about one half compared with conventional methods. Remote sensing technology has also been applied in archaeology, prospecting, railway and highway construction and marine information services.

11. As a country that suffers from frequent natural disasters of various kinds, China incurs annual losses of about 100 billion yuan through calamity damage. China places special emphasis on environment and disaster monitoring with remote sensing technology and the Geographic Information System. Application of the Global Positioning System has evolved from local engineering projects to nationwide coverage, forming a new generation of geodetic framework and a comprehensive GPS service system.

12. In the late 1980s, meteorological services in China began to use ground-based systems for processing data received from meteorological satellites. As a result, the utilization of data from satellites has evolved from image analysis of a subjective and qualitative nature to quantitative extraction of meteorological parameters. Monitoring typhoons and analysing and forecasting storms with the help of meteorological satellites have led to positive social and economic benefits.

13. In China, tele-education is the field in which satellite technology has been most widely applied and is developing the fastest. There are currently nearly 20,000 cable television stations in China, 70 per cent of which are transmitting China's educational television programmes. Over 1 million students are enrolled in tele-education universities, among which 39 are classified at the national and provincial levels, while 577 are at the municipal and local levels, thus constituting a tele-educational system with nationwide coverage.

14. Communication network systems in China consist mainly of fibre optics, supplemented by microwaves and satellites. More than 23,400 two-way domestic routes and 25,000 international routes via communication satellite are available. In the field of finance, network structures of bank headquarters and their primary branches have been developed in China through data transmission via satellite. Stock exchanges have also set up their own remote terminals.

15. Very small aperture terminal communication systems open to the public have entered into operation in China one after another, offering data transmission services in ticketing for civil aviation, maritime forecasting, earthquake monitoring, financial information, market quotations of securities and futures, as well as in customs, petroleum and railway operations, improving communications in remote areas.

II. Vision of future space activities in China

A. Future space science

16. Development of common hardware equipment for space fluid experiments is expected to be completed by the year 2000. The programme of telescopic observation of the solar magnetic field will be continued to allow observation of and research on the fine structures of the solar magnetic field using a specialized telescope of 80 cm in diameter. Falling capsules of high quality from balloons for microgravity scientific research will also be developed.

17. Cultivation and investigation of animal and plant cells and their organic blocks will be undertaken through international cooperation. During short-term microgravity experiments on board aeroplanes, research will be conducted on the correlation between the electrophoretic direct current field and the variable gravity field with electrophoretic instruments for continuous free current stream in space and equipment for life science experiments on manned space missions will be developed and relevant scientific research initiated.

18. During the solar maximum year, a mission of double star terrestrial space exploration will be implemented to investigate the impact of changes in the plasma environment in terrestrial space on solar activities, inter-planetary perturbations, the dynamics at magnetopause as well as the global response process of magnetic storms and substorms, so as to build physical models of magnetopause and models of other relevant changes, contributing to the development of solar terrestrial space physics at the beginning of the next century.

19. Research work on large-calibre solar telescopes will be pursued further and a new generation of the FY-3 polar orbit meteorological satellite will be launched to improve satellite weather bulletin service further.

B. Future space technology and its applications

20. Focus will be placed on the development of application satellites for communication and broadcasting, Earth observation and so on. Research will be carried out on the development of large geostationary bus platforms, large-capacity communication satellites, television direct broadcasting satellites and data-relay satellites to establish a satellite communication network that covers the whole country and the surrounding areas and is operated autonomously and on a regular, long-term basis.

21. On the basis of the construction of small modern satellite bus platforms and breakthroughs in small satellite constellation technologies, small satellites or constellations of them will be developed to constitute a fairly comprehensive network of application satellites in accordance with the actual needs of China's national economy.

22. Efforts will be made (a) to develop and establish a meteorological satellite series consisting of geostationary satellites and polar orbit satellites; (b) to develop and establish an Earth resource satellite series consisting of Earth resource satellites and (a cluster of) small Earth observation satellites; (c) gradually to set up a comprehensive system of Earth observation satellites for resource, meteorological, marine, environment and disaster monitoring; and (d) to establish and further improve a comprehensive application system of satellite remote sensing, with capabilities for medium- to long-term forecasting, processing and assessing under all weather conditions and at all times for resource exploration and environmental and disaster monitoring.

23. Use will be made of domestic and foreign navigation and positioning satellite systems to promote their application in civil aviation, roads, railroads, water transport, maritime transport, finance, agriculture, mapping, tourism and security defence. China will build its own

high-accuracy satellite navigation and positioning systems in due course to allow the gradual emergence of an application industry for navigation and positioning technologies.

24. Efforts will be made to enhance the reliability of the existing Long March (LM) series of launch rockets and to expand and improve their launching capacities. Costs for their development, production, launching and operation will be brought down, while launching services will be improved. Research will be carried out on new types of launch vehicle and new generations of launch instrumentality will be developed. Research will also be undertaken at an appropriate time on reusable space launch vehicles, while launch vehicles for small satellites will be developed.

25. Manned space flight will be undertaken as appropriate. Deep-space exploration and space technological experiments will be conducted on a limited scale. Efforts will be made to develop China's space laboratory and to conduct manned space exploration and operate a technological space laboratory through international cooperation at an appropriate time.

III. International exchanges and cooperation

26. The Government of China maintains that exploration and utilization of outer space should be in conformity with the international law and based on the principles of peaceful purposes, equality, mutual benefit, free competition and mutual development. International cooperation in the peaceful uses of outer space should be enhanced and promoted. The role of the United Nations in developing the international space law and strengthening the legal order in space should be brought into full play.

27. China is a member of the Committee on the Peaceful Uses of Outer Space and a State party to the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, the Convention on International Liability for Damage Caused by Space Objects and the Convention on Registration of Objects Launched into Outer Space. National legislation on space is also under preparation in China.

28. Having signed bilateral and multilateral cooperation agreements with more than a dozen countries, China has established long-term cooperative relationships and carried out cooperation in various areas. The Government of China will strive to expand its cooperation in space with other countries of the world so that space technology can serve the benefits of mankind to a greater and better extent.

29. Being a developing country with a vast territory, a varied topography, a large population and a weak economic foundation, China is confronted with a tremendous challenge of modernization and construction, and space technology, as one of the most sophisticated technologies in the contemporary world, is not only a representation of the overall national strength, but also an important means to transcend the phase of traditional development and accelerate economic and social development. The Government of China will continue to encourage and support the development of China's own space activities.